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Drip System Installations

In this section, we will cover how to install the three main types of drip irrigation systems that are commonly used; gravity feed, vegetable garden and grapevine installation. While these types of systems all deliver water though drip, the water source, installation and layout methods are quite different. Read about the system installation and layout that applies to your plants and needs.

What We Will Cover

- Drip System Installations
- Gravity Feed Irrigation
- Vegetable Garden Installation
- Grapevine Installation

Drip System Installations

About Retrofit

Retrofit systems can be used to convert an existing sprinkler head to a drip system without altering the flow, or other capabilities of the original design. Retrofit drip heads are available in 4, 6, or 12 outlets, and can be used with individual plant, groups of plants, or as part of any irrigation system. The adapters are available with 1/2" FPT and a 1/4" outlet to be used with pots or hanging baskets. The 1/2" FPT by 3/4" MHT adapter convert 1/2" risers to start a new drip system. Both parts may be installed as part of a new system. To convert from an existing sprinkler, remove the sprinkler head from the riser, screw on the retrofit head of your choice, extend from head to plant with micro tube and secure with a stake.

Gravity Feed Drip Irrigation System

In gravity feed irrigation systems, water takes the path of least resistance. If you place drip tubing or a garden hose on the ground and punch holes every few inches, the openings closest to the water source will discharge much more water than the openings farther down the line. If the distance is long enough, water may not reach the last holes on the line. Distances can be as long as 50 feet or as little as 10 feet. This will depend on the height of the bucket/barrel, the pressure available, the size of the pipe and the flow uniformity of the system.

Barrel Size

By selecting a low flow dripper, such as .5 GPH (2 L/H), and then raising the pressure by raising the height of the bucket from the ground, the efficiency and uniformity of a gravity feed drip irrigation system can be improved. The use of drippers gives better control of flow rate than poking holes in the tubing and the water passage structure of the dripper gives a better uniformity to the irrigation system.

With gravity feed drip irrigation systems, you may need to fill the barrel daily or every other day. The only ways to adjust the time to empty the barrel, or to adjust the drippers' flow rates, are to close the ball valve in front of the barrel, change the height of the barrel, the volume of the barrel, and/or the total number of drippers in the system. Note that with gravity feed systems the size of the system is limited by the size of the barrel; in general, a barrel large enough to provide adequate flow and pressure to increasingly larger areas would quickly become unmanageable. As more outlets (drippers) are added to the line, uniformity decreases, with more water at the beginning of the line and less at the end. In addition, as the water level in the barrel drops, the drippers' flow rate drops.

Water Pressure

To have an effective gravity feed drip irrigation system; consider the size of the barrel and the number of drippers. Our suggestion is to make sure that the flow rate per outlet is at least .03 GPH.

Gravity feed systems using drip irrigation need a minimum pressure to operate. To gain pressure in gravity feed systems, use this calculation:

To gain water pressure by using gravity means you must raise the water source (barrel) above the system lines. For every 1' (12 cm) of elevation above the system there is a gain of .433 PSI (.030 bar). This means that if the water source is 10 feet (3m) above the system there is a pressure of 4.33 PSI (.30 bar) at the start of the system (.433 x 10 = 4.33).

Keep in Mind

Low pressure, such as 4.33 PSI (.30 bars) or less, will lead to:

1. Limited distance to the layout, the 1/2" or 1/4" drip tubing.
2. Reduction in the flow rate (.5 GPH recommended) for the drip emitters to below the manufacturer's suggested flow rate.
3. A drastic drop in uniformity once a certain length is exceeded.

Installing Gravity Feed Drip Irrigation System Using a 50-Gallon Bucket

A 10 x 12 ft gravity feed system with 5 rows, each 10' long using a 1/4"drip line with pre inserted drippers every 12" (30 cm):

The chart below is for a gravity feed drip irrigation system using a 1/4" drip line with drippers every 12" (30 cm). This design uses a 50 gallon (38L) bucket with 9 gallons (30L) of water at a pressure range less than 1 PSI on flat terrain.

Barrel Size	Height Above the Drip System	Length of Drip Line Run	Dripper Flow Rate	Container Close to Empty in:
50 Gallon	8"	10'	.034 GPH 1.28 l/h	Around 2.50 hours
50 Gallon	12"	10'	.036 GPH 1.36 l/h	Around 2.40 hours
50 Gallon	12"	14'	.041 GPH 1.55 l/h	Around 2.30 hours
50 Gallon	16"	14'	.042 GPH 1.58 l/h	Around 2.20 hours

Installation of Gravity Feed Drip Irrigation System

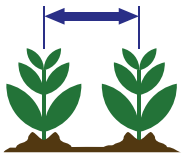
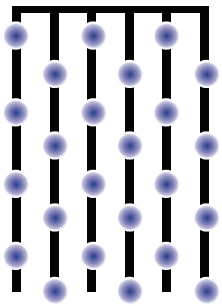
- First, drill a 3/4″ hole in the barrel about 1″ from the bottom (if no outlet).
- From inside the barrel, insert a 3/4″ x 1″ nipple with o-ring model SWF013 into the hole.
- Thread a model A029 3/4″ adapter to the nipple on the outside of the hole.
- Connect a 3/4″ filter model F303 to the adapter.
- Connect a ball valve model A123 to the filter.
- Connect a 4″ to 10″ section of the 1/2″ drip tubing to the ball valve.
- Connect a 1/2″ elbow model LF007 to the drip tubing.
- Add another section of 1/2″ drip tubing model T004 from the elbow to the ground.
- To the end of the 1/2″ drip tubing, add an additional elbow model LF007.
- Lay out the drip tubing model T004 to the garden and connect to the elbow.
- Punch a hole in the 1/2″ drip tubing and insert a 1/4″ barb model SF001 near each row of plants.
- To the barb, connect 10′ of 1/4″ drip line with drippers every 12″ model T047.
- Then use punch model A019 to punch the hole in the 1/2″ drip tubing, .
- Fill the barrel with water and turn the ball valve on to flush the line. As the water is running, close the end of the 1/2″ drip tubing using hose end model A006.
- Close the end of the 1/4″ drip line using the small side of the goof plug, model SF007.

Vegetable Garden Drip Irrigation

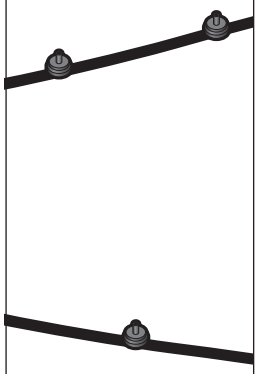
Most vegetable gardens are grown in rows and consist of two types of plantings. These are evenly spaced or densely planted. For either of the methods, select one of the systems below to install drip irrigation.

Basic Layout Tips

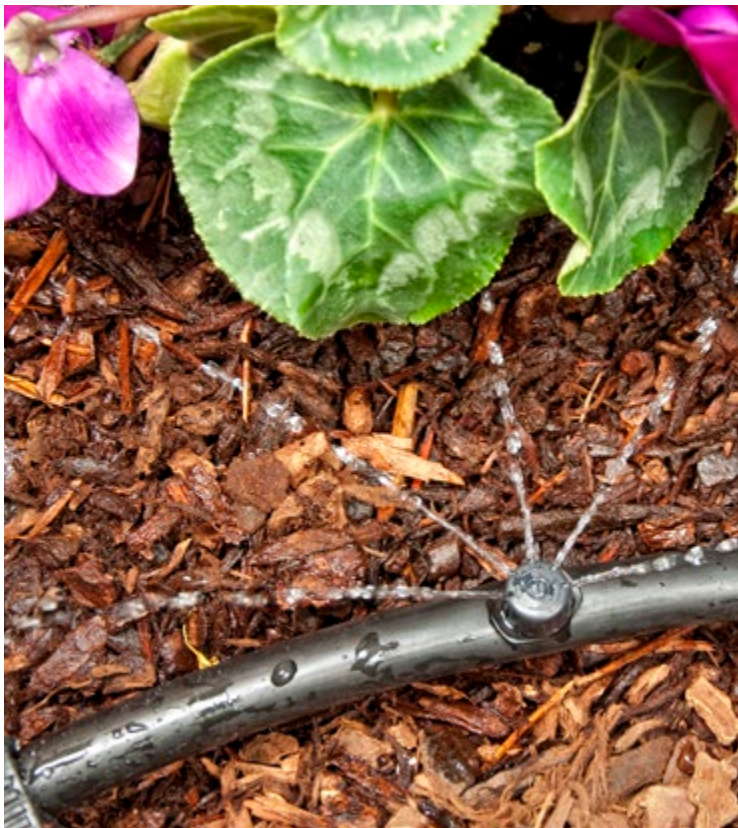
Before we get into the actual layout of the drip system we need to understand the underlying reasons for making layouts in different ways. There are various different types of vegetable gardens. We may not name your specific type of planting method, but a review of the most common should provide a good starting point.

Evenly Spaced		Use for plants like corn, tomatoes, peppers, lettuce and melons. Normal layout of the plants is in a row with all the plants spaced equally between 12” and 60” apart. The drippers should be spaced one per plant.
Densely Planted		This would include plants like carrots, radishes and most herbs. When growing these types of plants, some “thinning” may be done, but the plants will normally be very close together. With very closely grown plants you need to make sure that the entire area around the plants gets water. To do this, the drippers need to be placed 10” to 12” apart to ensure a very even distribution of water.
Button Drippers Inserted at Various Spacing on 1/2” Drip Line		This is definitely the most versatile method available. The basic installation is to lay out one drip tubing per each row (see picture). You can install the drippers at any spacing you like and you can use any dripper flow rate. We suggest that you select one flow rate for all plants. The tubing can be used year-after-year. The only real disadvantage with this system is the labor of installing the drippers and that it is not as easy to pick up and store for the winter as drip line and drip tape are.

Basic Layout Tips Continued

1/2" or 1/4" Drip Line With Pre-Inserted Drippers at Preset Spacing		This is the easiest way to install drip irrigation on rows in a vegetable garden. The drippers are pre-inserted in preset spacing inside the drip tubing. The 1/2" drip line can be run in very long lengths but the 1/4" has length limitations. Consider 1/4" lines for smaller rows of up to 15 ft. See detail specifications on 1/4" drip-line. The advantage of this system is that all the drippers' flow rates are the same, allowing you full control of the system flow rate. It is also easy to take up and store for the winter.
Drip Tape With Pre-Inserted Drippers at 12" Spacing		This is the most economical method and the easiest method to pick up and store during the winter. The drip tube (tape) is a thin walled tube with the drippers installed inside in a 12" spacing. The drip tape lies flat when the system is off and expands under water pressure. It works great for straight rows which can be very long. Drip tape uses a special type of fitting that is used only with the drip tape (See Fittings). The drip tape flow rate is 32 gallons per 100' per hour at a pressure of about 10 PSI (use with a 10PSI pressure regulator). The drip tape is not made for the same lifespan as the thicker walled tubing, but it can last for up to 5 years. No drippers can be installed into this tape because the wall thickness on the tubing will not support them.

No matter which layout you have, you can choose any of the above systems. You will have a number of parallel rows of plants with the drip lines running down them. You will supply water to each of these rows by having a main supply line running across one end of the rows and tapping into this line to supply the drip line running down each row. See pictures to get a better idea. Don't forget that the main supply line running across all the rows must be able to supply enough water for all the rows' requirements. Add up all the drippers' flow rates to get your total water requirements. Maximum recommended flow rate from a single 1/2" poly tube is 220 gallons per hour (GPH). If your total water requirement is more than this you might want to use 3/4" poly tube or a 3/4" or larger PVC main line. As with all drip systems, be sure you start with a filter and then a pressure regulator. If you need to automate the system, use one of our battery control units.



Grapevine and Tree Drip Irrigation

Vineyards have long since known the effects of the harsh summer on their vines. During the summer months, temperatures can reach as high as 105 degrees Fahrenheit, enough to boil the juices within the grapes. This high temperature combined with a lack of rain for several days at a time will dry out the soil thus leaving the vine to starve for nutrients. To combat the drought, please see our recommendation for drip irrigation systems, which will provide the vines with a constant watering, and the additional option of injecting fertilizer.

Drip Irrigation in Grapevine

Drip irrigation installation for grapevines use a wire for support and a drip hose as a supply line that feeds the drip emitter. The drip emitter we recommend is a .5 or 1 GPH pressure compensating barbed dripper that lets a .5 or 1 GPH to flow in a range between 7 to 45 PSI. The water drips out of the drip emitters and provides a microclimate and deep watering.

Soil Preparation

Many types of soils are used for growing grapes, but they are most successfully grown in sandy or fine sandy loams with average fertility and good drainage. In soils low in fertility, grapes grow slowly and produce low yields; on extremely fertile soils, vines usually grow excessively and the crop matures late. Fine, tight soil that contain much clay are not suitable for grape production. Regardless of soil type, the drainage must be good. Impervious layers of clay closer than 5 ft to the surface may cause poor drainage and salt accumulation.

Irrigation Layout

Unless drip irrigation is to be used, the land for a vineyard should be leveled and disked before plants are set. Grapevines used with drip system are planted 6 to 8 feet apart in rows, and rows are separated 8 to 12 feet.

The distance between rows depends on the trellis used. In commercial vineyards, adequate space must be provided for roads at the ends, sides and center of the vineyard for easy access during harvests and cultural operations. Twenty to 30 feet is generally adequate for driveways.

Set a post 2 x 2 inches or larger beside the vine. The post should be 30 to 36 inches above the ground.

If the selected cane seems weak, cut it back to two buds in the second spring. If it is vigorous, do not cut it back. Tie the cane and the future shoot that is to form the trunk to the post. Remove all lateral shoots. When the vine shoot is within 6 inches of the top of the post, cut off the terminal to encourage laterals to form the head.

System Layout

Filter	Most flow rate requirements will use a 150-mesh filter (screen or disk).
Water Source	Run the main line to the vineyard using PVC pipe buried underground. This way you can mow or disk down through the rows without having to worry about your mainline. There are adapters available to go from the PVC pipe to the 1/2" drip tubing.
Riser	Near each row, have a PVC tee with 3/4" female pipe thread. From the tee, install a 3/4" flex riser x 12" to 18" long.
3/4" Ball Valve	For each row install a ball valve at the end of the riser.
Tee	From the riser, use a tee to connect to the drip line and run the tubing 8" - 12" above the ground and attach it to the wire using drip locks.
1/2" Drip Tubing	Run the tubing as desired to your vineyard. Run a wire from post to post 8" - 20" inches above the ground. Use drip locks to attach the 1/2" tubing to the #9 gauge wire. Insert the emitters (.5 or 1 GPH) into the tubing at each side of the vine. At the end of each row, install a figure 8" hose end.
Before Closing	Pressurize the system and flash the line before closing the end of the line and installing the drippers. Close the end of the line and then insert the drippers.
Emitters	Install a .5 or 1 GPH PC emitter on each side of the vine about 10" from the plant. Run each section for 6 to12 hours at a time (depends on watering requirement), and then turn on to a different section.

Irrigation Requirements

The amount of water and frequency of application necessary to meet the needs of grapevines grown in different soil types vary considerably. Soil moisture must always be present in the root zone during the growing season, especially when the most rapid growth of the berries occurs. Young vines must be watered more frequently than older vines, particularly during the first year. Bearing vines grow rapidly in spring and early summer. Normally, a gradual slowing of shoot growth occurs as the berries enlarge. Growth rate continues to slow and almost stops as the fruit begins to ripen.

A shortage of available soil moisture greatly reduces the normal growth rate of a grapevine. A further reduction in moisture supply may be detected by the appearance of a soft, yellowish green color in the terminal leaves. Grapevines are quite tolerant to drought, but when heavily stressed, the soft-green color at the terminals turns to gray-green and plant growth almost stops.

Grapes grown on medium to heavy soils normally require 20 to 30 inches (51-76 cm) of irrigation water per season. In lighter sandy soils, 3 to 4 feet (91-122 cm) of water may be needed to produce satisfactory crops and normal growth.

The grape is a deep-rooted plant; therefore, apply heavy watering in winter and early spring, just before growth starts, to wet the soil to a depth of 6 to 8 feet (1.8-2.4 m). Developing shoots require little additional water during April and May. As the leaf area increases and the berries begin to enlarge, maintain available moisture throughout the root zone.

Did you know

In the first couple of years, the vine should not be allowed to produce fruit. It needs to strengthen its root system before it can support the extra weight of fruit.

Drip Irrigation Must Apply Water Uniformly to Be Efficient

In order to be efficient, a drip system must apply water uniformly throughout the vineyard. This is accomplished by having little variation in flow rate among drippers (high emission uniformity is available with a PC dripper). Dripper plugging and uneven pressure distribution are the major factors contributing to system inefficiencies.

The emission uniformity of a drip system can easily be measured. It is used to evaluate system design and maintenance. A stopwatch, measuring cup, pressure gauge with attachments and a little time is all that is needed to evaluate a drip system. The flow rate from at least 20 drippers should be measured from various locations in the system. Check drippers at the beginning and end of hoses and select hoses from the high pressure and low-pressure end of the underground manifold. One minute is all the time needed to measure the flow from a dripper. Dripper flow rates are expressed as gallons per hour.

Pressure distribution is evaluated by measuring pressure at the first and last drip line inlets on several manifolds as well as the high and low pressure end of hoses. Also, note the pressure at the pump and pressure loss across the main filter.

To determine the emission uniformity of a drip system, divide the average discharge of emitters with the lowest 25% flow rates by the average flow rates of all emitters. For example, after measuring the flow of 20 drippers, it was found that the average flow rate of all drippers was 1 gallon per hour; whereas, the average flows from the five with the lowest discharge was 0.8 gallons per hour. The calculated emission uniformity in this example is 80% (0.8 divided by 1).

Grading of emission uniformity is given in the table. A system with an emission uniformity of 90% or greater is operating efficiently. If watering is scheduled properly, irrigation efficiency will be high. When emission uniformity drops, the ability to irrigate efficiently also drops. For example, an emission uniformity of 50% would require over irrigating (2X), satisfying water requirements of vines that have drippers with low discharge. This can reduce yields, and waste water. The only solution is to improve the emission uniformity of the drip system.

Emission Uniformity Rating

90-100%	Excellent
80-90%	Good
70-80%	Fair
Less than 70%	Poor

Drip systems should be evaluated once a year. An effective evaluation will detect poor performance and then pinpoint the problem. Remember to document operation pressure when measuring emitter flows; otherwise, valid comparisons with past and future evaluations will be difficult (dripper flow rates change with pressure). It is a good policy to evaluate a newly installed drip system to establish a baseline for future evaluations.

The majority of the systems we have tested were operating with an emission uniformity of 80% or greater. Systems with poor emission uniformity had drippers that were plugged or problems with pressure regulation.

When plugging is a problem, the variation in dripper flow rates tends to be randomly distributed throughout the vineyard. However, when pressure regulation is the culprit, drippers with low flow rates are located at the ends of hoses (excessive drip line length) or at the low-pressure end of the manifold (manifold pipe too small).

In our system evaluations, high emission uniformity was evident in systems that were maintained properly, which includes servicing filters, flushing drip hoses and using appropriate chemical treatments. In a very few instances, poor system design was the culprit, requiring major changes in underground pipe or drip lines to improve emission uniformity.

Drip systems having well to excellent emission uniformity indicate that water and injected fertilizer are distributed evenly throughout the vineyard.

Question and Answer

When Is the Best Time to Water?

Drip irrigation systems provide your plants with the slow, deep, uniform supply of water they need, encouraging the growth of roots and enabling the plant to seek out water at different levels in the soil. Water in the morning when humidity is high and temperature is low. Allow the soil to dry slightly between watering. This enables air to mix with the soil particles and aid in plant growth. For the backyard grower we recommend watering three times a week for 8 - 10 hours at a time. If you have had a lot of rainfall, this would be decreased.

What Are Some Tips on Ensuring the Most Efficient Water Saving Action?

- Always use a pressure regulator at your water source to ensure proper pressure.
- Always use a punch when installing emitters so the drippers will not leak.
- Make sure no dirt enters your system during installation. If it does, flush system prior to using.
- Select the appropriate emitters and flow rates.
- For maximum water savings, water in the early morning.

Emitters Keep Getting Clogged With Dirt. What Can I Do?

If your emitters clog often, it may be a sign there is dirt in your water supply. In that case, you might want to consider adding a filter to keep out debris.

What Are the Design Criteria For Grapevines?

- Number of vines x 2 = the number of drippers require.
- Length of grape row x the number of rows = the amount of 1/2” drip line require.
- Number of 1 GPH drippers require ÷ by 60 = how many gallon per minute you need.
- How many gallon per minute you have ÷ by 4 for four section = the amount of water you will need per hour for a 2 acre of grape.

Drip Irrigation for Windbreaks

Windbreaks or shelterbelts can be used to protect homeowners, farmers, ranchers and rural residents in a windy, hot, or open field region. A properly designed tree windbreak or shelterbelt can provide protection for crops, orchards and livestock. A windbreak can also mean significant energy savings for heating a rural residence.

Drip irrigation systems can help establish successful tree planting and help them become effective windbreaks at an earlier date than non-irrigated trees. Drip irrigation installed for windbreaks can have the following benefits:

Water Efficiency

By applying water only where and when it is needed, with less runoff and less evaporation from leaves and soil, the uniform application of water from drip irrigation systems can achieve high water savings and faster plant growth.

Ease of Installation

The system can be installed without special tools or glue and with limited knowledge, making the installation a very simple process.

Reduced Pest Problems and Weed Growth

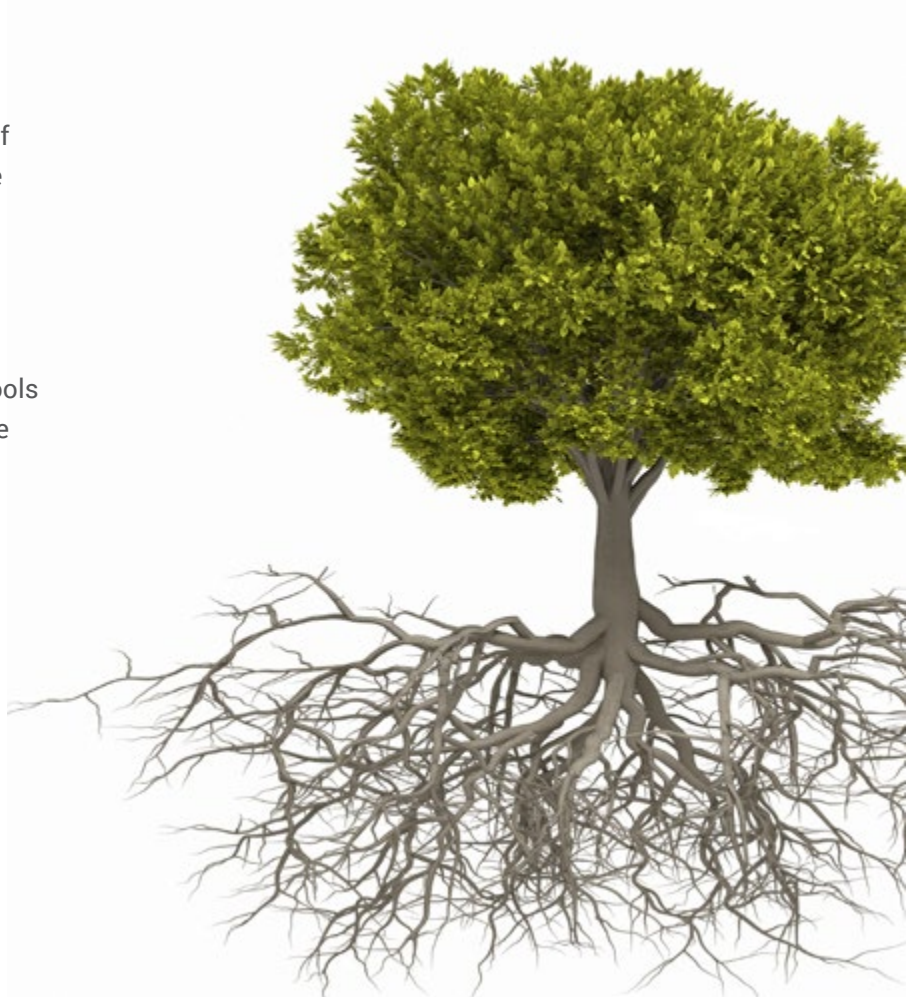
Watering only the roots of your trees with drip irrigation cuts down on water-borne pests and fungal diseases that spread by water movement, as well as the germination of weeds in the area between your trees.

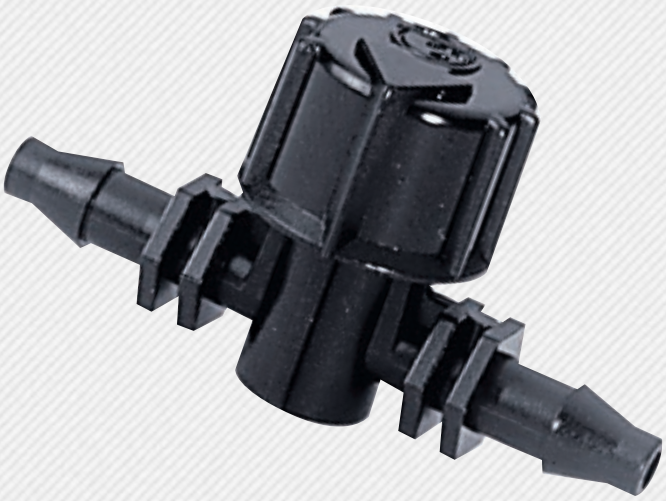
Versatility

Drip irrigation systems are designed for placement in both new and existing areas, and are ideal for installation on difficult terrain such as slopes, oddly shaped areas and windy sites.

Root Zone

One benefit of a drip irrigation system is the creation of a totally new and more favorable root zone environment because of the maintenance of a relatively constant soil moisture level. This has important implications for trees' water requirements, tolerance, and control of disease.





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Chapter in Review

System Installations

To get the most out of your drip system, it is important to find the system installation and layout that applies to your plants and needs. Different drip systems have specific components and watering layouts. We hope that this chapter has thoroughly explained the main types of drip installations. Use the check list to the right to insure that you have selected the best system for your landscape or garden.

If you ever have any questions regarding which system installation or layout to use, you can always call our Customer Care team at The Drip Store. We're available Monday through Friday, 7 a.m.-4 p.m. (PST) at 760-597-1669 or toll free at 877-597-1669.

Choosing The Best System

Drip System Installations

- **Retrofit Drip Heads ◯ 4 ◯ 6 ◯ 12 Outlet**
- **Adapters ◯ 1/2" FPT ◯ 1/4" Outler**

Gravity Feed Irrigation

- **Barrel Size _____ Gallon**
- **Height Above _____ Inches**
- **Length of Drip Line Run _____ Feet**
- **Dripper Flow Rate _____ GPH _____l/h**
- **Container Close to Empty in _____ Hours**

Vegetable Garden Installation

- **Space Between Plants _____ Inches**
- **Button Dripper Spacing _____ Inches**

Grapevine Installation

- **Vines x 2 = _____ Drippers Required**
- **Length of Grape Row x _____ Number of Rows = of 1/2" Drip Line Require**
- **_____ r of 1 GPH Drippers Require ÷ by 60 = _____ GPM Needed**
- **_____ GPM ÷ _____ Number of Sections = Water/ Hour Per 2 Acre of Grape**